

EMOTIONS ON AGENT BASED SIMULATORS FOR GROUP FORMATION

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ABSTRACT

Time and space consuming are key factors in a meeting, and therefore must be object of consideration in any process of socialization. So, group decision simulation could be a valuable training tool, through which it will be possible to create and test virtual group decision scenarios. In this work we propose a multi-agent simulator of group decision making that models the participant cortex by considering its emotional states and the exchange of arguments among them.

INTRODUCTION

In daily life we continually make individual decisions, even if we are not conscious of that. The scope of those decisions vary from trivial problems, like ‘what clothes should I dress to go to work’ to relevant economic and political decisions.

In spite of the great variety of Decision Support Systems, in general they present themselves as simple tools, built according to an user perspective. However, taking decisions in group, rather than individually, may bring some advantages. Aspects like the organizational complexity, the globalization and the internationalization of the markets contribute significantly for the growth of this kind of processes. Taking decisions around table is not an easy task. For instance, many of the decisions of the every day life will acquire a new dimension (e.g. the choice of a place to take vacations, buy a car, hire an employee or select a place to build a new airport). If the group members are dispersed, the need of coordination, informal and formal communication, and information support will increase significantly.

The increase of group decision making processes in organizations contributed to the emergence of Group Decision Support Systems (GDSS). Generically, we may say that GDSS aim to reduce the losses associated to this type of work (e.g. time consuming, high costs, improper use of group dynamics) and to maintain or improve the gains (e.g., groups are better in problems understanding and in flaw detection; participants’ different knowledge and processing skills allow for results that could not be achieved individually). The use of GDSS allows for groups to integrate the knowledge of all members into better decision making processes.

Along the last 20 years several GDSS were developed, some dedicated to be used exclusively in decision rooms and others with features to support ubiquitous group decision meetings (Karacapilidis and Papadia 2001; Group Systems/URL).

More recently surged some agent based group decision support systems (Ito and Shintani 1997; Kudenko et al. 2003; Zamfirescu et al. 2001; Payne et al. 2000). On the other hand, simulation proved to be a valuable technique in a range of areas like individual decision making (what if scenarios), e-commerce, crisis situations, traffic simulation, military training, entertainment. Indeed, simulation can be also very useful in the group decision making, once:

- Through it is possible to create virtual group decision scenarios, where the human decision makers can test, for instance, different argumentation strategies and learn from it.
- The training of decision makers is less expensive than the real thing.
- It may be very useful to test “what if scenarios” like, for instance, to test the reaction of to whom was sent an argument with a threat.

The idea of using agent’s technology to simulation environments is not new. According to Damasio (Damasio 1994), multi-agent systems offer strong models for representing real-world environments with an appropriate degree of complexity and dynamism.

In previous work, we state that the use of multi-agent systems seems very suitable to simulate the behaviour of groups of people working together and, in particular, to group decision making modelling, once it caters for a broad range of issues, such as individual modeling, flexibility and data distribution (Marreiros et al. 2006).

In classical decision theory proposals are sort by individual decision makers in order to maximize the expected utility. However, if we transpose those choices to quotidian life, it must be taken in consideration that our decisions are influenced by the emotions and moods that one’s feeling. The inclusion of affect in individual or group decision processes will allow to explain (simulate) a variety of decisions and observe behaviours, which are difficult to justify under classic decision theory.

There are two different ways to give support to decision makers (Zachary and Ryder 1997). The first one is supporting them in a specific decision situation. And the second one is to give them training facilities in order to acquiring competencies and knowledge that they can use in a real decision meeting.

In this work we propose a multi-agent simulator of group decision making that intends to model the participant cortex considering their feelings, and that allows for the exchange of arguments among them. Decision groups are automatically formed but with the knowledge acquired during the several group decision simulations we intended to model a group formation process.

This paper is organized as follows. Section 2 provides a general approach to role of emotion in decision making processes and presents a brief overview of some of the existent architectures for emotional agents. A model to simulate agent based group decision making is proposed in section 3. We will focus in the emotional component, which is based on the Ortony Clore and Collins (OCC) model (Ortony 2003). Section 4 details some implementation aspects. Finally section 5 presents conclusions and gives some perspectives and ideas for future work.

EMOTION

The terms emotion, mood and affect are many times used indistinctively. Affect is the more general and usually is used to refer to mood and emotion. Emotion is normally referred to as an intense experience, of short duration (second to minutes), with a specific origin, and in general the individual is aware of it. In contrast, moods have a propensity to be less intensive, longer lasting (hours or even days) and remain under unconscious. Moods may be caused by an intense or recurrent emotion, or yet by environmental changes. In what follows the term emotional state will be used to refer to the set of the individual emotions and mood.

Emotion and Decision

Only a few years ago, specialists in decision making started to consider emotion as a factor to be considered in the decision making process. Antonio Damásio (Damasio 1994) proposed a somatic marker hypothesis which describes how emotions are biologically indispensable to decisions. This hypothesis posits that deficits in emotional signal lead to deficient judgment in decision making, especially in the individual and social sphere. According to Damásio, experiments with neurological patients affected by brain damage, shows that the absence of emotion and feelings can break down rationality. In psychological literature several examples could be found on how emotions and moods affects the individual decision making process. For instance, individuals are more predisposed to recall memories that are congruent with their present emotional state. There are also experiences that relate the influence of emotional state in information seeking strategies and decision procedures. The emotional state of an individual has impact in their behaviour, as well as in their interactions with the other group members. The individual emotional state changes with time and is influenced by the emotional state of the remaining members of the group. The process of emotional contagion could be analysed based on the emotions that a group member is feeling or based on the group members mood (Neumann and Strack 2000). A more detailed review of the influence of emotion in group decision making can be found in (Marreiros et al. 2005).

One of the reasons pointed by Rosalind Picard (Picard 2003) to give machines emotional characteristics is the necessity of obtaining a better understanding of the human emotions. As it was seen before, the individual emotional state affects its performance and its relationships inside the group. In this work, it is postulated that the simulation of group decision scenarios will make possible to handle emotions in a way that will allow one to have a better representation and an increasing understanding of the reality.

Architectures for Emotional Agents in MAS

Attending to what has been referred to above, some architectures for emotional agents have been proposed. For instance, Velasquez presents a model called Cathexis (Velasquez and Maes 1997) to simulate emotions, moods and temperaments in a multi-agent system. In his architecture only the basic emotions (i.e., anger, fear, distress / sadness, enjoyment / happiness, disgust, and surprise) are included. In Cathexis, it is presupposed that the simulation of emotional mechanisms implies the interpretation the neurological structures that support emotions. Cathexis follows the somatic marker hypothesis proposed by Damásio. Cathexis was used to implement several synthetic characters like Simón the Toddler (synthetic agent representing a young child) and Virtual Yuppy (a simulated emotional pet robot).

The Flame (Fuzzy logic adaptive model of emotions) emotional model was proposed by El-Nasr (El-Nasr et al. 2000) and is based on fuzzy logic. Flame is composed by three models: emotional, decision making and learning. The emotional model is mainly based on the OCC model. Flame architecture is designed for a single agent, and does not incorporate functionalities related to group behaviour.

Urban and Schmidt propose the PECS (Physics, Emotion, Cognition, and Social Status) reference model (Schmidt 2002; Urban 2000). PECS is an architecture for multi-agent systems, which aims modelling and simulating the human behaviour. PECS agents contain information that falls into four categories: physical (the agent's physical condition), emotional (agents feelings), cognitive (agents plans, model of the self and model of the environment) and social status (relations in the community of agents). A simulation model named Adam was developed to test and demonstrate the PECS architectures capabilities.

Salt&Peper architecture was proposed by Luís Botelho and Hélder Coelho (Botelho and Coelho 2001). Salt&Peper is architecture for autonomous agents that aims to implement mechanisms to allow artificial agents being as successful as natural agents. The roots of this architecture are in neuroscience and cognitive science; the authors boost the adaptive role of emotions. Generically we may say that the architecture aims to develop control mechanisms to artificial agents that are emotional based. The Safira project uses the Salt&Peper architecture for the implementation of its agents (Paiva et al. 2001).

Hyungil Ahn and Rosalind Picard proposed a computational framework of affective-cognitive learning and decision making for affective agents. This framework is inspired by human learning, neuroscience and psychology (Ahn and Picard 2006).

SIMULATOR DESCRIPTIONS

In previous work, it was identified the main agents involved in the simulation of a group decision (Marreiros et al. 2006), namely: Participant Agents, the Facilitator Agent, the Register Agent, the Voting Agent and the Information Agent.

In the remain of this section, we will focus on the architecture of participant agents, due to their main role in group decision making, and in particular on the Emotional module. At this moment, only the participant agents have emotional characteristics, however is possible to extend this characteristics to the facilitator agent (the responsible for the simulation).

Participant Agent Architecture

In figure 1 it is represented the architecture of participant agents. This architecture comprises the knowledge layer, the reasoning layer and the communication layer.

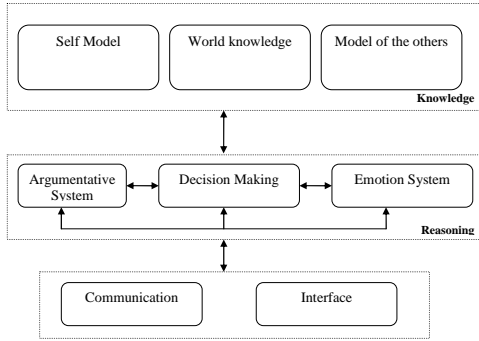


Figure 1: Participant Agent Architecture

In the knowledge layer, the agent has information about the environment where it is situated, about the profile of the other participant agents, in terms of its own preferences and goals. The information in the knowledge layer is dotted of uncertainty, evolving according to the agent interaction with its peers.

The communication layer is responsible for the communication among agents and the user interface.

The reasoning layer contains three major modules:

- The argumentative system – that is responsible by the arguments generation. This component will generate explanatory and persuasive arguments, which are related to the agent emotional state and about its thinking on its peers (Analide and Neves 2002).
- The decision making module – it will support agents in the choice of the preferred alternatives and will classify all the set of alternatives into classes, namely preferred, indifferent and inadmissible.
- The emotional system – it will generate emotions and moods, affecting the choice of the arguments to be sent to the other team members, the evaluation of the received arguments and the outcome.

Emotional Module

The emotions that will be simulated in our system are those identified in the reviewed version of the OCC (Ortony 2003) model, namely, joy, hope, relief, pride, gratitude, like, distress, fear, disappointment remorse, anger and dislike.

An emotion in our system is characterized by the following properties: if it is positive or negative, moment in time when it was initiated, identification of the agent or event that cause the emotion and emotion intensity.

The user will setup a set of rules to configure the emotion generation. The system is prepared to allow the configuration of all the set considered in the OCC model, but the user may just opt to configure a subset of that.

In Figure 2 it is possible to visualize the main components of the emotional system.

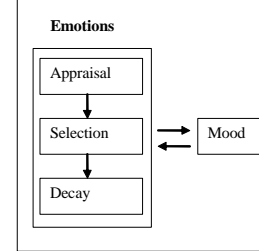


Figure 2: Emotional Module

The emotional module is composed by three main components: appraisal, selection and decay. The agent mood is determinate based on the emotions felt.

Appraisal

The appraisal mechanism is based on OCC model, where the user defines the conditions for the emotion activation. An example may be:

$$\begin{aligned} \text{Hope}(\text{AgP}_i, X) &:- \text{Goal}(\text{AgP}_i, X), \\ &\text{Request}(\text{AgP}_j, X). \end{aligned}$$

In the previous example, the emotion Hope is appraised if Agent AgP_i has the goal (X) and asks to agent AgP_j to perform the goal X. A weight, in the interval [0,1], is settled for each condition of the emotion generation. The emotion intensity is computed according the conditions weight. A particular emotion depends on the intensity of the others emotions.

Selection

All the emotions defined in the simulator have a threshold activation that can be influenced by the agent mood. The activation threshold is a value between 0 and 1. This component selects the dominant emotion.

$\text{AgP}_{i, \text{Emo}, t}$ is the set of all the emotions generated by the agent AgP_i and the respective intensities and activation thresholds.

$$\text{AgP}_{i, \text{Emo}, t} = \{(\text{Emo}_1, \text{Int}_1, \text{Act}_1), \dots, (\text{Emo}_n, \text{Int}_n, \text{Act}_n)\}$$

The selected emotion in instant t, $\text{AgP}_{i, \text{ActEmo}, t}$, will have a higher differential between the intensity and the activation.

Decay

Emotions have a short duration, but are not instantaneous (they have a period of decay). There are several proposals for this calculation. In our model, it is considered three possibilities, namely, linear, exponential and variant.

The decay rate may be the same for positive and negative emotions. It is also possible to settle different rates for positive and negative emotions, in that case the user should choice the variant decay rate.

Mood

The agent mood is calculated using the felt of emotion in the past and what the agent thinks about the moods of the remaining participants. In our approach, the process of mood contagion is the only one to be considered. The process of emotion contagion is handled. We consider three stages for mood, namely, positive, negative and neutral. The mood of a specific participant is determined according to the following:

$$K^+ = \sum_{i=t-n}^{t-1} I_i^+, \quad K^- = \sum_{i=t-n}^{t-1} I_i^-$$

K^+ and K^- are the sum of the positive/negative emotions felt in the last n periods, and n can be parameterized by user. Only emotion values above the threshold activation are considered.

$$\begin{cases} \text{if } K^+ \geq K^- + l, \text{ then positive mood} \\ \text{if } K^- \geq K^+ + l, \text{ then negative mood} \\ \text{if } |K^+ - K^-| < l, \text{ then neutral mood} \end{cases}$$

The value of l varies according to the mood of the remaining group members.

$$\begin{cases} l = 0.10, \text{ if group mood is positive} \\ l = 0.05, \text{ if group mood is neutral} \\ l = 0.01, \text{ if group mood is negative} \end{cases}$$

Each participant agent has a model of the other agents, in particular, it has information about the other agent's mood. This model considered incomplete information handling and the existence of explicit negation, following the approach described in (Analide and Neves 2002). Some of the properties that characterize the agent model are gratitude debts, benevolence, credibility, (un)preferred arguments, and reputation (Andrade et al. 2005). Although, the emotional component is based on the OCC model. The inclusion of mood can surpasses one of the major critics that usually is pointed to this model, the fact that OCC model does not handle the treatment of past interactions and past emotions

IMPLEMENTATION

A prototype of the multi-agent model proposed in the previous section is being developed in order to validate the model. In this section, we present some details of our implementation.

The prototype is being developed in Open Agent Architecture (OAA) (OAA -URL)], Java and Prolog. The participant agents are being developed in Prolog, while the other agents that compose the proposed model are developed in Java. The implementation of the AgPs in Prolog is related to the existence of incomplete and negative information in the knowledge base of each AgP, and on the necessity of measuring the quality of that information. OAA has an Interagent Communication Language (ICL) that is shared by all agents independently of the language in which they are programmed or the operating system of the machine where the agents reside. The ICL language is close to KQML. OAA imposes a common protocol for agents entering and registering at the group decision making simulator.

In Figure 3, it is possible to see the emotional configuration process. In this particular case the user is configuring the emotion Hope that has an activation threshold of 0.5 and the decay rate used is variable. Figure 3 presents a configuration of a simulation; in this case the goal is to simulate the acquisition of a house by a family.

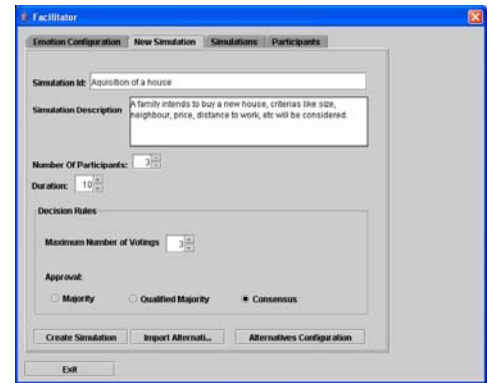
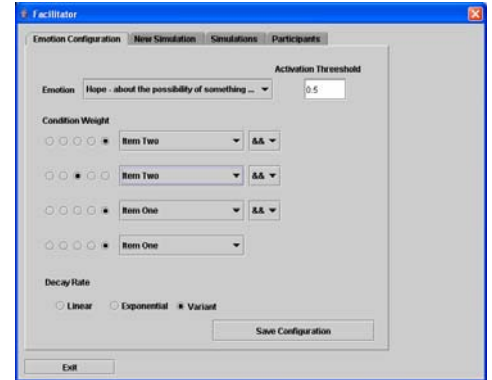


Figure 3: The simulator parametrics

Figure 4 shows the agents that exist at a particular moment in the simulator: 10 participant agents, the facilitator agent, the voting agent, the clock agent (OAA is not vocalized for simulation, therefore it was necessary to introduce a clock agent to control the simulation) and the application agent (responsible by the communication between the community of agents and the simulator interface).



Figure 4: Community of agents

CONCLUSION

We propose an agent based group decision simulator, which aims to simulate the behaviour of persons involved in group decision. In this simulator, each group member is represented by a separate agent, which facilitates the simulation of entities with different behavioural characteristics. The inclusion of an emotional module will allow for its users to obtain a better representation of the reality. The simulator is flexible, once it is easy to add or remove a participant from the scenario during a simulation. This work is focused on the emotional system. However another important component of the participant agent architecture is the argumentation system that has been already approached in (Marreiros et al. 2006).

Futures developments of this model will include factors like credibility, reputation and the member hierarchy inside the organization.

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